

WHAT IS CLAIMED IS:

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1. A method for reducing a precision of an input datum having precision portion and a loss portion, comprising:
- a. comparing the loss portion to a preselected threshold value,  $f_t$ ;
  - b. determining a selectable bias,  $\alpha$ , responsive to the loss portion being in a defined relation to the preselected threshold value,  $f_t$ ; and
  - c. combining the precision portion with  $\alpha$ , creating a reduced precision datum thereby,
- wherein  $\alpha$  corresponds to a predetermined characteristic of one of  $\alpha$ , the input datum, the reduced precision datum, and a combination thereof.
2. The method of claim 1, wherein determining the selectable bias further comprises one of:
- a. assigning a first value to  $\alpha$ , responsive to the loss portion being substantially equal to  $f_t$ ;
  - b. assigning a second value to  $\alpha$ , responsive to the loss portion being less than  $f_t$ ; and
  - c. assigning a third value to  $\alpha$ , responsive to the loss portion being greater than  $f_t$ .
3. The method of claim 1, further comprising determining the selectable bias responsive to a predetermined characteristic

of a plurality of input data relative to a corresponding plurality of reduced precision data.

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4. The method of claim 1, further comprising determining the selectable bias responsive to a predetermined characteristic attributable to reducing the precision of the input datum.

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5. The method of claim 1, further comprising determining the selectable bias responsive to the predetermined characteristic of the selectable bias, the predetermined characteristic being the mean value of a plurality of selectable bias values.

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6. The method of claim 2, further comprising determining the selectable bias responsive to a predetermined characteristic of a plurality of input data relative to a corresponding plurality of reduced precision data, and the predetermined characteristic being attributable to reducing the precision.

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7. The method of claim 6, wherein the predetermined characteristic is a predetermined mean error value.

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8. The method of claim 2, further comprising determining the selectable bias responsive to a predetermined characteristic

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of one of input data, a corresponding reduced precision data, and a combination thereof.

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9. The method of claim 8, wherein the predetermined characteristic comprises a predetermined statistical value.

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10. The method of claim 4, wherein the predetermined characteristic comprises a predetermined mean error value of the plurality of reduced precision data relative to a corresponding plurality of input data.

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11. The method of claim 9, wherein the predetermined statistical value comprises the mean value of the reduced precision data relative to a corresponding plurality of finite-precision fixed point input data.

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12. The method of claim 2, further comprising assigning a fourth value to  $\alpha$ , responsive to a being substantially equal to  $f_t$ , the fourth value being in a predefined relationship with the ~~first~~ value.

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13. The method of claim 12, further comprising determining the selectable bias responsive to a predetermined characteristic of input data relative to corresponding reduced precision

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data, and the predetermined characteristic being a  
preselected mean error value associated therewith.

14. The method of claim 12, wherein:

- a. the  $f_t$  is approximately equal to  $0.5_{10}$ ;
- b. the first value is 1 when the value of the loss portion substantially equals about  $0.5_{10}$ , the input datum is a negative-valued datum, with the first value being added to the precision portion;
- c. the second value is zero when value of the loss portion is less than about  $0.5_{10}$ ;
- d. the third value is 1 when the value of the loss portion is greater than about  $0.5_{10}$ , with the third value being added to the precision portion;
- e. the fourth value is 0 when the loss portion substantially equals about  $0.5_{10}$ , and the input datum is a positive-valued datum; and
- f. the preselected mean error value relative to the input datum and the reduced precision datum is minimized.

15. The method of claim 11, wherein:

- a.  $f_t$  is substantially equal to  $0.5_{10}$ ;
- b. the first value is a current first value being selected to be one of '1' and '0' when the value of

the loss portion substantially equals about  $0.5_{10}$ , in a predefined relationship to a previous first value;

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- c. the second value is zero when the loss portion is less than about  $0.5_{10}$ ; and
- d. the third value is 1 when the loss portion is greater than about  $0.5_{10}$ , with the third value is added to the value of the precision portion.

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16. The method of claim 14, wherein the predefined relationship is an alternating relationship.

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17. The method of claim 16, wherein the alternating relationship is a toggle relationship with the current first value being zero if the previous first value was 1, and the current first value being 1 if the previous first value was zero, and wherein the preselected mean error value is minimized responsive to the alternating relationship.

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18. The method of claim 15, wherein the alternating relationship includes a selectable number of 1's being interleaved with a selectable number of zeros, the mean value of the reduced precision data being responsive to the alternating relationship.

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19. The method of claim 2, wherein each of the input datum and  
the reduced precision datum are represented by two's  
5 complement fixed point values.

20. The method of claim 16, wherein the alternating relationship  
10 includes a selected pseudorandom sequence of data bits.

21. A method for rounding a first datum,  $X$ , having precision of  
 $a$  digits, to a second datum,  $X$ , having precision of  $b$  digits,  
15 wherein  $a > b$ , first  $b$  digits of  $X$  being a precision portion, and  
remaining  $a-b$  digits of  $X$  being a loss portion, the method  
comprising:

- 20 a. evaluating the loss portion relative to a preselected  
rounding threshold value;
- b. if the loss portion is substantially equal to the  
preselected threshold, then defining  $X$  according to  
the equation:

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$$X = X + 2^{-(b+1)} \alpha,$$

where  $\alpha$  is a selectable bias represented by a rounding  
digit;

- c. if the loss portion is not substantially equal to the  
preselected threshold, then defining  $X$  according to  
the equation:

$$X = X + 2^{-(b+1)}; \text{ and}$$

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- d. eliminating the loss portion of  $X$ , producing  $\hat{X}$  thereby.

22. The method of claim 21, wherein selectable bias  $\alpha$  is representative of a predetermined characteristic of one of  $X$ ,  $\hat{X}$ ,  $\alpha$ , and a combination thereof.

23. The method of claim 22, wherein the preselected threshold is substantially equivalent to  $0.5_{10}$ .

24. The method of claim 23, wherein the predetermined characteristic comprises a preselected mean error value of  $\hat{X}$  relative to  $X$ .

25. The method of claim 24, wherein the preselected mean error value,  $E(e)$ , is substantially defined by the equation:

$$E(e) = 2^{-a}(E(\alpha) - \frac{1}{2}),$$

where  $E(\alpha)$  is a mean value of selectable bias  $\alpha$ .

26. The method of claim 25 wherein the mean value of the selectable bias is substantially within the range of

$$0.0 \leq E(\alpha) < 1.0$$

27. The method of claim 26, wherein the mean value of the selectable bias,  $E(\alpha)$ , is approximately equal to

preselected mean error value,  $E(e)$ , and  $E(\alpha)$  is approximately zero.

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28. The method of claim 27, wherein the predetermined characteristic further comprises a preselected error variance value,  $\sigma_e^2$ , substantially defined by the equation:

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$$\sigma_e^2 = \frac{2^{-2b} + 2^{-(2a-1)}}{12}$$

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29. The method of claim 28, wherein the rounding digit is selected from a alternating sequence of digits in the pair of digits  $\langle 0, 1 \rangle$ .

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- 30 The method of claim 28, wherein the rounding digit is selected from a pseudorandom sequence of binary digits.

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31. A method for rounding a first two's complement fixed point datum,  $X$ , having an integer part of  $n$  bits, a fractional part of  $a$  bits the integer part, and sign bit,  $s_1$ , to a second two's complement fixed point datum,  $X'$ , having a fractional part of  $b$  bits following the radix point, where  $a$  and  $b$  are representative of the respective precisions of  $X$  and  $X'$ , and where  $a > b$ , comprising:

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- a. evaluating the fractional part of  $X$  and defining  $y$  as the most significant bit (MSB) of the  $a$  bits;
  - b. if the first bit following the radix point of  $X$  is equal to a 1 bit trailed by  $(a-1)$  zero bits, then defining  $\hat{X}$  according to the equation:

$$\hat{X} = n + s_1$$

and

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- c. otherwise, defining  $\hat{X}$  according to the equation:

$$\hat{X} = n + y$$

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32. The method of claim 31, wherein the occurrence of positive numbers and negative numbers in a plurality of the datum,  $X$ , is substantially equiprobable.

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33. A method for rounding signal values, comprising:

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- a. detecting a predetermined state value wherein rounding is desired; and

- b. rounding the state value according to one of
  - i. an alternating round-up/round-down method and
  - ii. a sign addition round-up/round-down method.

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34. An arithmetic device, comprising a bias generator producing a selectable bias  $\alpha$ , responsive to a predetermined signal characteristic, the device receiving an input signal and

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coupling the selectable bias  $\alpha$  thereto.

5 35. The arithmetic device of claim 34, further comprising  
a combiner coupled to the bias generator, the combiner receiving  
and combining the input signal and the selectable bias  $\alpha$ , and  
10 producing an output signal.

36. The arithmetic device of claim 34 further comprising  
wherein the bias generator further comprises a comparator for  
15 comparing the input signal to a preselected threshold value, the  
comparator urging the bias generator to produce the selectable  
bias  $\alpha$  responsive to the preselected threshold value.

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